Часть 1

Олимпиада: **Физика, 11 класс (1 часть)**

Шифр: **21200796**

ID профиля: **207637**

Вариант 6

~~В~~ лист 1 Чистовик Физика, 11 класс

№2.

По закону Менделеева-Клайперона

$pV = \nu RT \Rightarrow T \sim pV$

1) $\frac{T_1}{T_2} = \frac{p_1 V_1}{p_2 V_2}$

По графику $\sin\alpha = \frac{p}{p_0 r}$, где r - безразмерная величина, радиус окружности, α - угол с горизонталью.

$\cos\alpha = \frac{V}{V_0 r}$; $p = p_0 r \sin\alpha$; $V = V_0 r \cos\alpha$

$$\frac{T_1}{T_2} = \frac{p_0 r \sin\alpha_1 \cdot V_0 r \cos\alpha_1}{p_0 r \sin\alpha_2 V_0 r \cos\alpha_2} = \frac{\sin 2\alpha_1}{\sin 2\alpha_2} = \frac{\sin 135^\circ}{\sin 30^\circ} =$$

$$= \frac{\sqrt{2} \cdot 2}{2} = \sqrt{2}$$

2) $\delta Q = p\Delta V + C_{V_\mu} \Delta T$

$$T = \frac{pV}{\nu R} = \frac{p_0 V_0 r^2 \sin\alpha\cos\alpha}{\nu R} = \frac{p_0 V_0 r^2 \sin 2\alpha}{2\nu R}$$

$$\Delta T = \frac{p_0 V_0 r^2}{2\nu R} \cdot \cos 2\alpha \cdot 2\, d\alpha = \frac{p_0 V_0 r^2 \cos 2\alpha\, d\alpha}{\nu R}$$

окр. $\Rightarrow \frac{p^2}{p_0^2} + \frac{V^2}{V_0^2} = r^2$

$$p^2 = r^2 p_0^2 - V^2 \cdot \frac{p_0^2}{V_0^2}$$

$$p = \sqrt{r^2 p_0^2 - V^2 \cdot \frac{p_0^2}{V_0^2}} = \sqrt{r^2 p_0^2 - V_0^2 r^2 \cos^2\alpha \cdot \frac{p_0^2}{V_0^2}} =$$

$= r p_0 \sqrt{1 - \cos^2\alpha} = r p_0 \sin\alpha$ (α - угол I четв.)

лист 2 Чистовик Физика, 11 класс

$dV = V_0 r\,(-\sin\alpha)\,d\alpha$

$p\,dV = -r^2 p_0 V_0 \sin^2\alpha\,d\alpha$; $c_{V\mu}\Delta T = \dfrac{5 p_0 V_0 r^2 \cos 2\alpha\,d\alpha}{2}$

$\delta Q = \frac{5}{2} p_0 V_0 r^2 \cos 2\alpha\,d\alpha - r^2 p_0 V_0 \sin^2\alpha\,d\alpha$

(Но это δQ при переходе из 2 в 1
(~~положительное напра~~ угол увеличивается против часовой стрелки)

$\delta Q_{1-2} = r^2 p_0 V_0 \sin^2\alpha\,d\alpha - \frac{5}{2} p_0 V_0 r^2 \cos 2\alpha\,d\alpha$

$C = \dfrac{\delta Q}{\Delta T} = 0 \Rightarrow \delta Q = 0$

$\frac{5}{2} p_0 V_0 r^2 \cos 2\alpha\,d\alpha - r^2 p_0 V_0 \sin^2\alpha\,d\alpha = 0$

$\frac{5}{2}\cos 2\alpha = \sin^2\alpha$

$\frac{5}{2}(1 - 2\sin^2\alpha) = \sin^2\alpha$

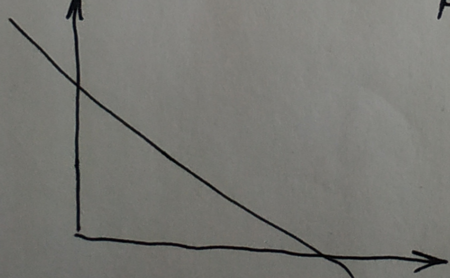
$2{,}5 - 5\sin^2\alpha = \sin^2\alpha$

$6\sin^2\alpha = \frac{5}{2}$

$\sin^2\alpha = \frac{5}{12}$

$\sin\alpha = \sqrt{\frac{5}{12}}$.

~~$A_{1-2} = \int_{67{,}5^\circ}^{15^\circ} r^2 p_0 V_0 \sin^2\alpha\,d\alpha = -r^2 p_0 V_0 \int_{67{,}5^\circ}^{15^\circ} \sin^2\alpha\,d\alpha$~~



$A_{1-2} = -\int_{67{,}5}^{15^\circ} r^2 p_0 V_0 \sin^2\alpha\,d\alpha =$

$= -r^2 p_0 V_0 \int_{67{,}5^\circ}^{15^\circ} \sin^2\alpha\,d\alpha =$

$r^2 p_0 V_0 \int_{15^\circ}^{67{,}5^\circ} \sin^2\alpha\,d\alpha$

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Чистовик лист 3 Физика, 11 класс

$$A_{\text{общ.}} = r^2 p_0 V_0 \int_{15^\circ}^{67{,}5^\circ} \sin^2\alpha \, d\alpha - \Delta U_{2-1}$$

$$\Delta U_{2-1} = \frac{5}{2} \nu R (T_1 - T_2) = \frac{5}{2} \nu R T_1 \sqrt{2} = \frac{5\sqrt{2}}{2} p_1 V_1 =$$

$$= \frac{5\sqrt{2}}{2} \cdot \frac{1}{2} \cdot \sin 2\alpha_1 \cdot p_0 V_0 r^2 = \frac{5\sqrt{2}}{2} \cdot \frac{1}{2} \cdot \frac{\sqrt{2}}{2} \cdot p_0 V_0 r^2 =$$

$$= \frac{5}{4} p_0 V_0 r^2$$

$$A_{\text{общ.}} = p_0 V_0 r^2 \left(\int_{15^\circ}^{67{,}5^\circ} \sin^2\alpha \, d\alpha - \frac{5}{4} \right)$$

$$\frac{A_{\text{общ.}}}{A_{1-2}} = 1 - \frac{5}{4 \int_{15^\circ}^{67{,}5^\circ} \sin^2\alpha \, d\alpha}$$

Ответ: 1) $\frac{T_1}{T_2} = \sqrt{2}$; 2) $\arcsin\sqrt{\frac{5}{12}}$ 3) $1 - \frac{5}{4 \int_{15^\circ}^{67{,}5^\circ} \sin^2\alpha \, d\alpha}$

Черновик

$\sin^3\alpha$

$V = V_0 r\cos\alpha$

$\alpha' = 3\sin^2\alpha\cdot\cos\alpha$

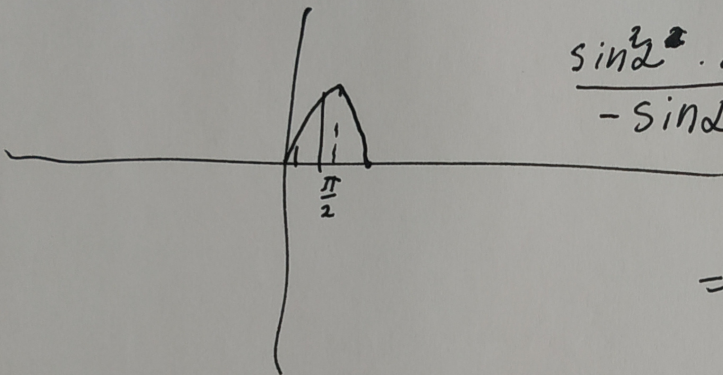
$pdV = -r^2 p_0 V_0$

$\frac{\sin^3\alpha}{\cos\alpha} = \cancel{3\sin^2\alpha}$

$t = \cos\alpha$

$\sin^2\alpha$

$dt = -\sin\alpha\, d\alpha$



$\frac{\sin^2\alpha\cdot dt}{-\sin\alpha} = -\int \sin\alpha\, dt =$

$= -\int\sqrt{1-t^2}\,dt$

$t^2 = w$

$t = \frac{1}{\cos\alpha}$

$1-t^2 = w$

$dt = -1\cos\alpha^{-2}\cdot(-\sin\alpha) = \frac{\sin\alpha}{\cos^2\alpha}d\alpha$

$-\int\frac{w^{0,5}}{2t}dw$

$d\alpha = \frac{dt\cos^2\alpha}{\sin\alpha}$

$dw = 2t\,dt$

$2t\,dt = dw$

$\int\sin^2\alpha =$

$dt = \frac{dw}{2t}$

$\cancel{\int\sqrt{2-t}}$

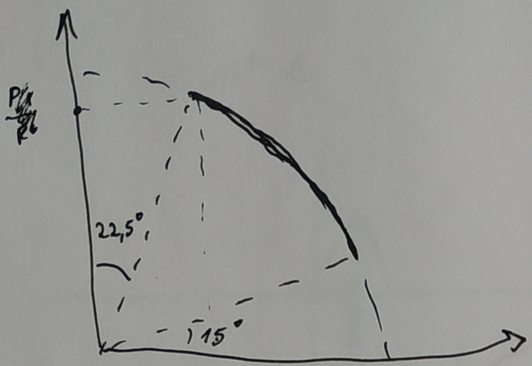
Черновик

$$\frac{T_1}{T_2} = \frac{p_1V_1}{p_2V_2} =$$

$$p_1^2V_0^2 + p_0^2V_1^2 = C$$

$$p_2^2V_0^2 + p_0^2V_2^2 = C$$

$$V_0^2(p_1^2 - p_2^2) + p_0^2(V_1^2 - V_2^2) = 0$$



$$p^2V_0^2 + V^2p_0^2 = const$$

$$V_0^2 \cdot p\dot{p} + p_0^2 V = 0$$

$$\frac{p_{max}^2}{p_0^2} = \frac{V_{max}^2}{V_0^2}$$

$$tg\alpha = \frac{p\,V_0}{p_0\,V}$$

$$tg\alpha_1 = \frac{p_1V_0}{V_1p_0}$$

tg

$$p = \frac{const}{V}$$

$$V^{-1} = -1 \cdot V^{-2}$$

$$V_0^2 \cdot \frac{p_0V_0}{V} \cdot \frac{p_0V_0}{V^2} + p_0^2 V = 0$$

$$\sin(90 + 45°) = \frac{\sqrt{2}}{2}$$

$$\sin\alpha = \frac{p}{p_0 \, const_p}$$

$$\frac{V_0^4}{V^3} = V$$

$$\cos\alpha = \frac{V}{V_0 \, const_V}$$

$$p = p_0 \, const_p \sin\alpha$$

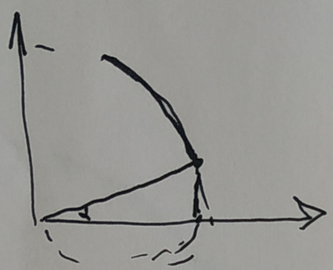
$$V = V_0 \, const_V \cos\alpha$$

$$\frac{T_1}{T_2} = \frac{p_1V_1}{p_2V_2} = \frac{\sin\alpha\cos\alpha}{\sin\beta\cos\beta} = \frac{\sin 2\alpha}{\sin 2\beta} = \frac{\sin 135°}{\sin 30°} = \sqrt{2}$$

Термодин

$\frac{i+2}{i}$ $\qquad T \sim pV$

$$C = \frac{dQ}{dT} \qquad t_1 =$$



$$\cos\alpha = \frac{V}{V_0 \cancel{\text{const}}\, r}$$

$$\frac{V}{V_0} = r$$

$pV(\alpha)$

$$p\Delta V + V\Delta p = \nu R \Delta T$$

$$p\Delta V = \nu R \Delta T - V \Delta p$$

$$\sin\alpha = \frac{p}{p_0 \cdot r}$$

$$\cos\alpha = \frac{V}{V_0 \cdot r}$$

$$pV = \sin\alpha\cos\alpha \cdot p_0 V_0 \cdot r^2 = \frac{1}{2}\sin 2\alpha\, p_0 V_0 r^2$$

$$pV = \nu R T$$

$$T = \frac{\sin 2\alpha\, p_0 V_0 r^2}{2\nu R}$$

$$Q = A_q + C_V \Delta T$$

$p^2 + V^2$

$$\frac{p^2}{p_0^2} = const - \frac{V^2}{V_0^2}$$

$$p^2 = const^* - V^2 \cdot \frac{p_0^2}{V_0^2}$$

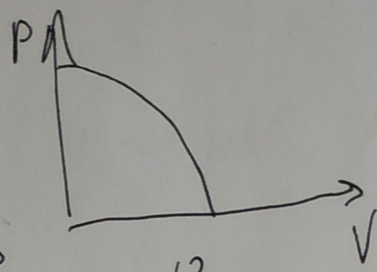
$\cancel{2p \cdot \dot{p}}$

$$p = \sqrt{r^2 \cdot p_0^2 + \frac{V^2 p_0^2}{V_0^2}}$$

Черновик

$$\frac{p^2}{p_0^2}+\frac{V^2}{V_0^2}=\cancel{const}\ r^2$$

написать вар



$$\int \sin^2\alpha\, d\alpha$$

$$\int 1-\cos^2 d\alpha$$

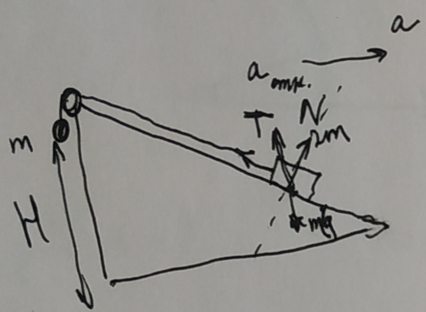
$$p^2+V^2=const$$

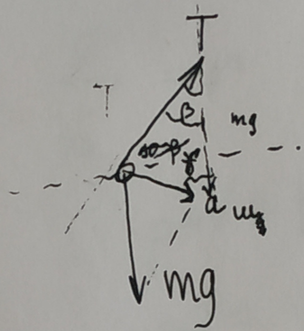
$$\int u\,dv = uv-\int v\,du$$

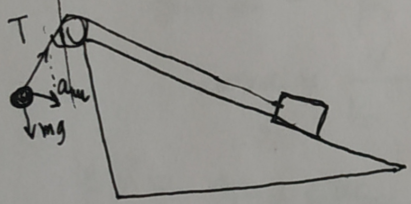
$$\left[\begin{matrix} u=\sin\alpha & dv=\sin\alpha\, d\alpha \\ du=\cos\alpha\, d\alpha & v=-\cos\alpha \end{matrix}\right]$$

$$-\sin\alpha\cos\alpha-\int\cos^2\alpha\, d\alpha$$

$$\frac{T}{\sin\gamma}=$$



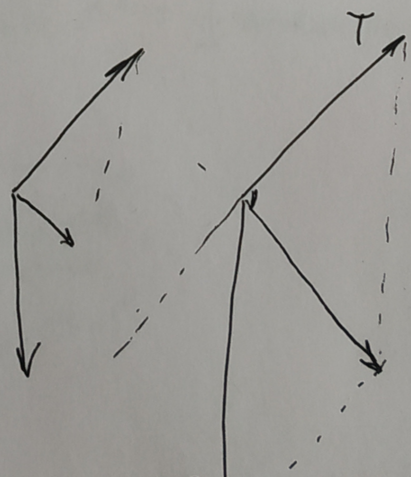




$$S=\frac{\alpha}{360}$$

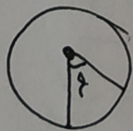
$$ma_{ц}=\sqrt{T^2+m^2g^2-2\cdot\frac{12}{13}\cdot mgT}$$

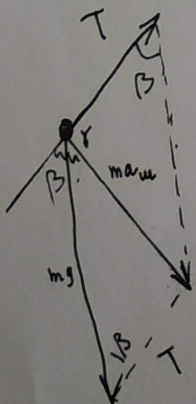
90 - 22,5 - 15



$$\int 1\, d\alpha - S$$

$$\int \sin^2\alpha\, d\alpha=-\sin\alpha\cos\alpha-\int\cos^2\alpha\, d\alpha$$





$$\frac{T}{\sin\gamma}=\frac{ma_{ц}}{\sin\beta}$$

$\cos^2\alpha$

$\cos\alpha$

$2\cos\alpha\sin\alpha$

$-\sin\alpha$

$$A_\phi = \sqrt{r^2 p_0^2 + \frac{p_0^2}{V_0^2} V^2}\, dV$$

$$\int \sin^2\alpha \, d\alpha$$

$\sin\alpha = t$

$dt = \cos\alpha \, d\alpha$

$\frac{dV}{d\alpha} =$

$V = V_0 r \cos\alpha$

$$\int \frac{t^2}{\cos\alpha} \frac{dt}{}$$

$dV = -V_0 r \sin\alpha \, d\alpha$

$$A_\phi = -\sqrt{r^2 p_0^2 + \frac{p_0^2}{\cancel{V_0^2}} \cdot \cancel{V_0^2} \cdot r^2\cos^2\alpha} \cdot V_0 r \sin\alpha \, d\alpha$$

$$A_\phi = -\sqrt{r^2 p_0^2 (1+\cos^2\alpha)}\, V_0 r \sin\alpha \, d\alpha =$$

$$= -p_0 V_0 r \sqrt{1+\cos^2\alpha}\, \sin\alpha \, d\alpha$$

$$\int \sin^2\alpha \, d\alpha$$

$$dT = \frac{p_0 V_0 r^2}{2\nu R} \cdot \cancel{1-\cos 2}\, \cos 2\alpha \cdot 2 =$$

$\cos\alpha = t$

$$= \frac{p_0 V_0 r^2}{\nu R} \cos 2\alpha \, d\alpha$$

$dt = -\sin\alpha \, d\alpha$

$$\int 1 - t^2$$

$$\delta Q = -p_0 V_0 r \sqrt{1+\cos^2\alpha}\, \sin\alpha \, d\alpha + \frac{5 p_0 V_0 r^2}{2\nu R} \cos\alpha \, d\alpha$$

$$c = \frac{\delta Q}{dT} = 0 \Rightarrow \delta Q = 0$$

$$-\sqrt{1+\cos^2\alpha}\, \sin\alpha + \frac{5r}{2\nu R} \cos\alpha = 0$$

$$\int \sin^2\alpha \cdot \frac{dt}{-\sin\alpha} =$$

$$= -\int \sin\alpha \, dt$$

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Часть 2

Олимпиада: **Физика, 11 класс (2 часть)**

Шифр: **21200796**

ID профиля: **207637**

Вариант 6

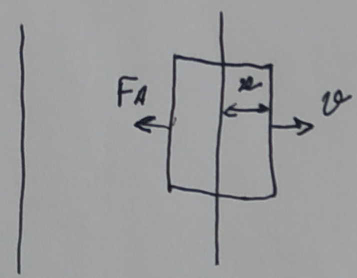
Физика 11 класс Чистовик Лист 2

$$v_{влет} = v_0 - \frac{bB^2d^2}{mR} = v_0 - \frac{B^2d^3}{4mR}$$

~~Т.к. пока~~ Когда тело влетит полностью магнитный поток через него перестанет меняться, значит $\mathcal{E}=0 \Rightarrow I=0 \Rightarrow F_A=0 \Rightarrow a=0$

Тело долетит до правой стороны рамки не меняя скорость.

$$v_1 = v_0 - \frac{B^2d^3}{4mR}$$



$$\mathcal{E} = -Bdv$$

$$F_A = -\frac{B^2d^2v}{R}$$

$$a = -\frac{B^2d^2}{mR}v$$

$$v = C_3 \cdot e^{-\frac{B^2d^2t}{mR}}$$

$$v(0) = v_1 \; ; \quad v = v_1 e^{-\frac{B^2d^2t}{mR}}$$

$$x = -\frac{mR}{B^2d^2}v_1 e^{-\frac{B^2d^2t}{mR}} + \frac{v_1 mR}{B^2d^2}$$

$$x = v_1\frac{mR}{B^2d^2}\left(1 - e^{-\frac{B^2d^2t}{mR}}\right)$$

$$e^{-\frac{B^2d^2t}{mR}} = \frac{v_1 mR - bB^2d^2}{v_1 mR}$$

$$v = v_1 - \frac{bB^2d^2}{mR} = v_0 - \frac{B^2d^3}{2mR}$$

Ответ: $1 - \frac{B^2d^2v_0}{mR}$, $v_0 - \frac{B^2d^3}{4mR}$; $v_0 - \frac{B^2d^3}{2mR}$

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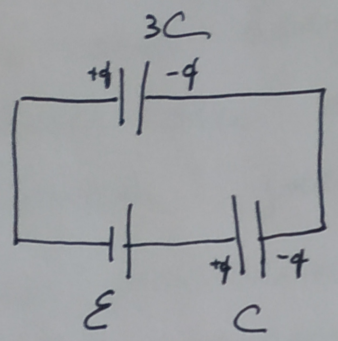
Физика 11 класс Чистовик Лист 3

№3. Пока ключ разомкнут

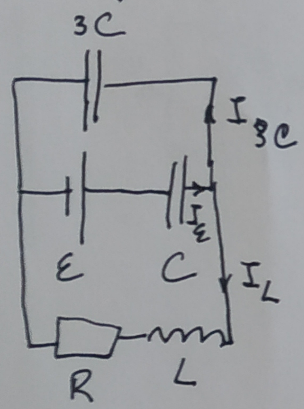


$$\mathcal{E} = \frac{q}{C} + \frac{q}{3C}$$

$$\frac{4q}{3C} = \mathcal{E}$$

$$q = \frac{3\mathcal{E}C}{4}$$

сразу после замыкания ключа заряд на C_1 не успел измениться, $I_L = 0 \Rightarrow I_R = 0$



$$\mathcal{E} = \frac{q}{C} + \dot{I}_L L$$

$$\dot{I}_L = \frac{\mathcal{E}}{4L}$$

2) $I_\mathcal{E} = I_{3C} + I_L$

$$\mathcal{E} = \frac{q_C}{C} + \frac{q_{3C}}{3C}$$

$$0 = \frac{I_C}{C} + \frac{I_{3C}}{3C}$$

$$I_\mathcal{E} = \frac{-I_{3C}}{3}$$

$$I_{3C} = -3I_\mathcal{E}$$

$$I_\mathcal{E} = -3I_\mathcal{E} + I_L$$

$$I_L = 4I_\mathcal{E}; \quad I_L = 4I_C$$

$$\int_0^\tau I_L = 4\int_0^\tau I_C = 4\left(q_C - \frac{3\mathcal{E}C}{4}\right)$$

q_R - q протекший через R =

$= 4q_C - 3\mathcal{E}C$; $q_C = \frac{q_R + 3\mathcal{E}C}{4}$

Физика 11 класс Чистовик Лист 4

$$\cancel{\mathcal{E} = \frac{q_c}{C} + \dot{I}_L L + I_L R}$$

~~при $t \to \infty$~~

$$\cancel{I_L = 0 \qquad \dot{I}_L = 0}$$

$$\mathcal{E} = \frac{q_c}{C} + \dot{I}_L L + I_L R$$

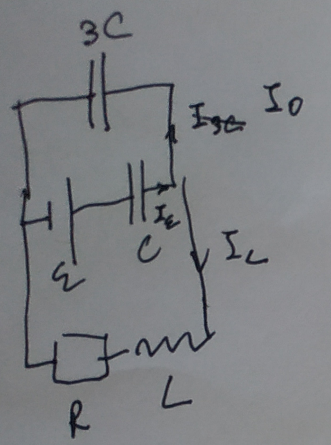
$$\mathcal{E} = \frac{q_R}{4C} + \frac{3}{4}\mathcal{E} + \dot{I}_L L + I_L R$$

$$t \to \infty : \quad \dot{I}_L = 0 \quad I_L = 0$$

$$\frac{q_R}{4C} = \; = \frac{\mathcal{E}}{4}$$

$$q_R = \mathcal{E} C$$

$\cancel{Q =}$



$I_\mathcal{E} = I_{3C} + I_L$

$\mathcal{E} = \frac{q_c}{C} + \frac{q_{3c}}{3C}$

$I_\mathcal{E} = -\frac{I_{3C}}{3}$

$I_{3C} = -3 I_\mathcal{E}$

$\mathcal{E} = \frac{q_c}{C} + \dot{I}_L L + I_L R$

$I_\mathcal{E} = -3 I_\mathcal{E} + I_L$

$I_\mathcal{E} = -\frac{I_{3C}}{3}$

$I_L = 4 I_\mathcal{E}$

$q_L + C = 4(q_c + C)$

$I_L = I_\mathcal{E} - I_0$

$q_L = 4\left(q_c + \frac{3\mathcal{E}C}{4}\right)$

$q_L = 4q_c + 3\mathcal{E}C$

$\mathcal{E} =^4$

$\frac{q_c - 3\mathcal{E}C}{4}$

$\mathcal{E} = \frac{q_L}{4C} - \frac{3\mathcal{E}}{4} + \dot{I}_L L + I_L R$

$\vartheta = \vartheta_0 - \frac{\cancel{d}^3 B^2}{4mR}$

$\frac{F_2}{F_1} = \frac{7}{3}$

$\frac{p_1}{p_2} = \frac{7}{3}$

$3F_2 = 7F_1$

$F_2 = \frac{7F_1}{3}$

$B = \frac{d}{4}$

$H = 8B$

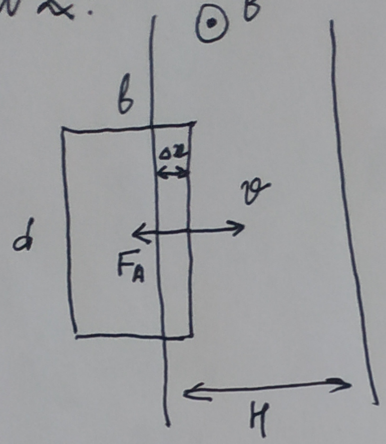
$d = 4B$

$\frac{1}{25} + \frac{1}{B} = \frac{1}{F_2}$

Физика 11 класс Чистовик лист 1.

№4!

1)



$$\left|\frac{\Delta \Phi}{\Delta t}\right| = |\mathcal{E}|$$

$$-\frac{Bd\Delta x}{\Delta t} = \mathcal{E}$$

$-Bdv = \mathcal{E}$, т.к. скорость не изменяется мгновенно

$v = v_0$

$\mathcal{E} = -Bdv_0$

$$I = -\frac{Bdv_0}{R}$$

$$F_A = IBd = -\frac{B^2d^2v_0}{R}$$

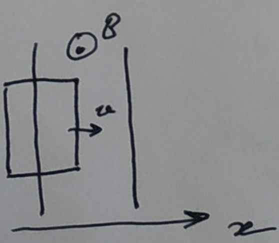
$$a = -\frac{B^2d^2v_0}{mR}$$ (рамка замедляется)

2) $$I = -\frac{Bdv}{R}$$

$$a = -\frac{B^2d^2}{mR}v$$ - пока рамка влетает в поле

$$v = C_1 \cdot e^{-\frac{B^2d^2t}{mR}}$$

$v(0) = v_0$; $\cancel{v=}$ $C_1 = v_0$; $v = v_0 e^{-\frac{B^2d^2t}{mR}}$



$$x = -\frac{mR}{B^2d^2}v_0 e^{-\frac{B^2d^2t}{mR}} + C_2$$

$\cancel{x(0)}$ $x(0) = 0$

$$C_2 = \cancel{mRB^2d}\ \frac{mR}{B^2d^2}v_0$$

$$x = v_0\frac{mR}{B^2d^2}\left(1 - e^{-\frac{B^2d^2t}{mR}}\right)$$

когда рамка залетела $x = b$

$$1 - e^{-\frac{B^2d^2t}{mR}} = \frac{bB^2d^2}{v_0 mR} ; \quad e^{-\frac{B^2d^2t}{mR}} = \frac{v_0 mR - bB^2d^2}{v_0 mR}$$

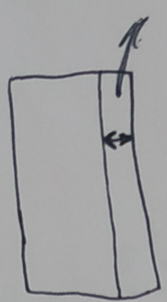
$$\frac{\Delta\Phi}{\Delta t} = \varepsilon$$

$$I = \frac{\varepsilon}{R}$$

$$\frac{\Delta\Phi}{\Delta t} = IR$$

$$\Delta\Phi = \Delta q R$$

$\Delta\Phi$



$$\Delta\Phi = B \cdot d \cdot \Delta x$$

$$\frac{\Delta\Phi}{\Delta t} = Bd v_0$$

$$Bd v_0 = \varepsilon$$

$$I = \frac{Bd v_0}{R}$$

$$F_A = IB\cancel{d}l = \frac{B^2 d^2 v_0}{R}$$

$$\varepsilon = IBl$$

$$\varepsilon = qBv$$

$$a = \frac{F_A}{m} = -\frac{B^2 d^2 v_0}{mR}$$

$$c = v_0 \frac{mR}{B^2 d^2}$$

$$\cancel{x = v_0 \frac{mR}{B^2 d^2}}$$

$$x = v_0 \frac{mR}{B^2 d^2}\left(1 - e^{-\frac{B^2 d^2 t}{mR}}\right)$$

$$v_0 \frac{mR}{B^2 d^2}\left(1 - e^{-\frac{B^2 d^2 t}{mR}}\right) = b$$

$$1 - e^{-\cdots} = \frac{bB^2 d^2}{v_0 mR}$$

$$e^{\cdots} = \frac{v_0 mR - bB^2 d^2}{v_0 mR}$$

$$\varepsilon = Bdv$$

$$I = \frac{Bdv}{R}$$

$$a\ \cancel{F_A} = \frac{B^2 d^2 v}{mR}$$

$$\boxed{a = -\frac{B^2 d^2}{mR} v}$$

$$v = \alpha \cdot e^{-\frac{B^2 d^2 t}{mR}} \qquad v = v_0 - \frac{bB^2 d^2}{mR}$$

$$\alpha = v_0$$

$$v = \alpha \cdot e^{-\frac{B^2 d^2 t}{mR}} \cancel{+c}$$

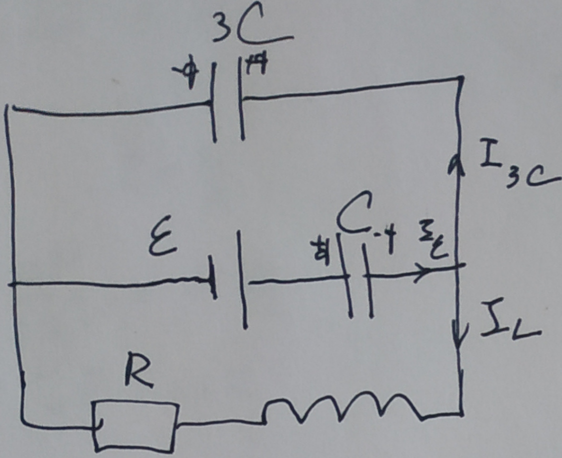
$$a = -\alpha \frac{B^2 d^2 t}{mR} \cdot e^{-\frac{B^2 d^2}{mR}}$$

$$v(0) = \alpha = v_0$$

$$v = v_0 e^{-\frac{B^2 d^2 t}{mR}}$$

$$\int v_0 e^{-\frac{B^2 d^2 t}{mR}} = v_0 \cdot \frac{mR}{-B^2 d^2} e^{-\frac{B^2 d^2 t}{mR}} + C$$

Черновик



$$\begin{cases} I_\varepsilon = I_{3C} + I_L \\ \varepsilon = \dfrac{q_C}{C} + \dfrac{q_{3C}}{3C} \\ \varepsilon = \dfrac{q_C}{C} + L\dot{I}_L + I_L R \end{cases}$$

$q_\varepsilon = \cancel{q_{3C} + q_L}$

$q_\varepsilon = q_C$

$\varepsilon = \dfrac{q}{C} + \dfrac{q}{3C}$

$0 = \dfrac{I_C}{C} + \dfrac{I_{3C}}{3C}$

$\varepsilon = \dfrac{4q}{3C}$

$\dfrac{I_{3C}}{3C} = -\dfrac{I_C}{C}$

$4q = 3\varepsilon C$

$q = CU$

$q = \dfrac{3\varepsilon C}{4}$

$\cancel{U =}$ $U = \dfrac{q}{C}$

$I_{3C} = -3I_C = -3I_\varepsilon$

$\cancel{I_\varepsilon}$ $I_{3C} = -3I_\varepsilon$

$\varepsilon = \dfrac{3\varepsilon}{4} + L\dot{I}_L$

$q_{3C} = -3q_\varepsilon + Const$

$\dot{I}_L = \dfrac{\varepsilon}{4L}$

$I_\varepsilon = I_{3C} + I_L$

$\cancel{\dot{q}_C = \dot{I}_{3C}\,\dot{q}_{3C} + I_L}$

$I_L = \dot{q}_C - \dot{q}_{3C}$

$\varepsilon = \dfrac{q_C}{C} + \dfrac{q_{3C}}{3C}$

$\dfrac{3\varepsilon C}{4} + \dfrac{9\varepsilon C}{4} + Const$

$\dfrac{q_{3C}}{3C} = I_L R + L\dot{I}_L$

$\dfrac{12}{4} = 3\varepsilon C$

$q_{3C} = 3\varepsilon C - 3q_{\varepsilon C}$